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ABSTRACT

Self-Validating Optimum Currency Areas*

In this Paper we show that a currency area can be a self-validating optimal policy regime, even when monetary unification does not foster real economic integration and intra-industry trade. In our model exporters choose the degree of exchange rate pass-through onto export prices given monetary policy rules, and monetary authorities choose optimal policy rules taking firms' pass-through as given. We show that there exist two equilibria, which define two self-validating currency regimes. In the first, firms preset prices in domestic currency only, and let foreign-currency prices to be determined by the law of one price. Optimal policy rules then target the domestic output gap and floating exchange rates support the flex-price allocation. In the second equilibrium firms optimally preset prices in local currency, and a monetary union is the optimal policy choice for all countries. Although business cycles are more synchronized with a common currency, flexible exchange rates are superior in terms of welfare.

JEL Classification: E50 and F40
Keywords: exchange rate pass-through, monetary union, nominal rigidities, optimal cyclical monetary policy and optimum currency areas

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1 Introduction

In the vast literature on optimum currency areas (OCAs), an influential contribution by Frankel and Rose [1997, 1998] has raised the possibility that a monetary union may become optimal *ex-post*, even though the individual countries that join it do not meet the optimality criteria *ex-ante*. The argument is rooted in the real effects of economic integration that is deemed to accompany monetary unification, due to the elimination of foreign exchange transaction costs. To the extent that economic integration enhances intra-industry trade rather than product specialization, national business cycles become more synchronized, as sectoral demand shocks and productivity innovations affect all countries at the same time. Higher national output correlation then reduces the need for exchange rate adjustments to stabilize national employment and prices, and minimizes the welfare costs of giving up national currencies. Using thirty years of data for twenty industrialized countries, Frankel and Rose [1997, 1998] provide empirical evidence that countries with closer trade links exhibit more tightly correlated business cycles — even after controlling for monetary regimes. Rose and Engel [2000] show that being a member of a common currency area increases international business cycle correlations by a significant amount.

In this paper, we point out a distinct argument for a theory of endogenous optimal currency areas, with conceptual roots in the Lucas critique. We show that — independent of economic integration — the adoption of a monetary union can be self-validating, in the sense that, when the private sector chooses pricing strategies that are optimal in the new monetary regime, such strategies make a monetary union optimal from the vantage point of the national monetary authorities.

Our argument is not that *any* common monetary policy is self-validating. There is *one* only monetary rule in a currency area that can be supported as optimal in equilibrium. In a monetary union profit-maximizing producers adopt behaviors that make exchange rate fluctuations highly costly in welfare terms; since optimal monetary design is conditional on firms' pricing choices, these limit the incentive for monetary authorities to pursue independent strategies of national output stabilization. As a result, even if there is no structural change in fundamentals (e.g., no increase in intra-industry trade), national outputs become more correlated than before the creation of a common currency area.

To develop our argument of a currency area as an optimal monetary arrangement, it is crucial to adopt a model allowing for an explicit welfare metric: a currency area could not be 'optimal' if monetary authorities did not implement a welfare-maximizing monetary strategy. The traditional tools of open-economy policy evaluation lack an explicit framework for assessing welfare under alternative monetary arrangements, and 'optimality' is typically presented in an informal way. For instance the welfare properties of a monetary union are assessed in terms of the ability by national authorities to stabilize output and employment in the absence of exchange rate flexibility.

In this paper we analyze endogenous optimal monetary unions within a general-equilibrium two-country, choice-theoretic stochastic setting where national welfare is measured by the utility of each country's representative household.[1] The key elements of our approach are imperfect competition in production, nominal rigidities in the goods markets, and forward-looking price-setting by firms. Drawing on our previous work (Corsetti and Pesenti [2001a]), our setup allows for imperfect pass-through of exchange rate onto export prices. In what follows, the degree of pass-through is endogenously chosen *ex-ante* by exporters, in the form of a rule of limited price flexibility contingent on exchange rate movements.

To distinguish our theory from the previous argument for endogenous optimal currency areas, we rule out a priori structural change: countries are perfectly specialized in the production of one type of good before and after the monetary union. Firms optimally choose prices and pass-through elasticities based on information on shocks and policy rules. Taking firms' pricing and pass-through strategies as given, monetary authorities choose optimal state-contingent monetary policy rules. In a world equilibrium, both the degree of pass-through and monetary policy are jointly determined by optimizing agents.

Our main result is quite surprising: in our economy there are two equilibria, which can be Pareto ranked. While in principle exporters could choose any intermediate level of pass-through, in equilibrium pass-through is either 100 percent or zero as producers optimally choose 'corner' pricing strategies

[1] Other contributions in the recent literature include Obstfeld and Rogoff [2000a, b], Devereux and Engel [2000], Corsetti and Pesenti [2001a], Benigno [2001], Clarida, Gali and Gertler [2001], Canzoneri, Cumby and Diba [2001]. On the welfare effects of a currency area when political factors influence monetary policy see Neumeyer [1998].

to prevent their markups from being affected by exchange rate fluctuations.[2] There is an equilibrium in which firms choose to preset prices in domestic currency, and let the foreign price adjust according to the law of one price. With complete pass-through, monetary policies are fully inward-looking, i.e. they implement stabilization rules that close national output gaps completely in every period. This equilibrium is inconsistent with fixed exchange rates, and implies low correlation among output levels — depending on the cross-country correlation of fundamental shocks. The exchange rate plays the role stressed in the enduring contribution by Friedman [1953]: it brings about the required relative price adjustments that are hindered by the presence of nominal price rigidities.

But there is another equilibrium in which firms preset prices in consumer currency. With zero pass-through (prices are sticky in different currencies), monetary policies are perfectly symmetric across countries, that is, they both respond to the same average of national shocks. This equilibrium is consistent with an OCA: there is no cost in giving up monetary sovereignty because, even if national monetary authorities remained independent, they would still choose to implement the same monetary rules, moving interest rates in tandem and responding symmetrically to world-wide shocks. This equilibrium implies perfect correlation of output levels even when shocks are asymmetric.

In welfare terms, the optimal monetary union is Pareto-inferior to the Friedman-style arrangement in the first equilibrium. Although the private and the public sector 'do the right thing' — in terms of policy and pricing strategies — once the equilibrium with a monetary union is selected, there is still room for welfare improvement by creating conditions for relative price adjustment via changes of the exchange rate. A move toward more volatile rates and less synchronized business cycles would bring about the appropriate change in firms' pricing and pass-through strategies, which in turn would validate the floating regime as optimal.

This paper is organized as follows. Section 2 develops the model. Section 3 studies price-setters' optimal behavior and endogenous pass-through strategies for given monetary policies. Section 4 focuses instead on optimal monetary policies given firms' pricing strategies. The previous two pieces

[2] Related literature focuses on the choice of pricing strategies where monetary authorities are assumed to implement non-optimizing, *noisy* policies (as in the work by Bacchetta and Van Wincoop [2001] and Devereux and Engel [2001]) rather than optimal rules.

of analysis are brought together in sections 5 and 6, which characterize the equilibrium of the economy. A final section discusses our main results.

2 The model

2.1 Preferences, technology and budget constraints

Following Corsetti and Pesenti [2001a] we model a world economy with two countries, H (Home) and F (Foreign), each specialized in one *type* of traded good. Each good is produced in a number of *brands* defined over a continuum of unit mass. Brands are indexed by h in the Home country and f in the Foreign country. Each country is populated by households defined over a continuum of unit mass. Households are indexed by j in the Home country and j^* in the Foreign country.

Home agent j's lifetime expected utility $\mathcal{W}$ is defined as:

$$\mathcal{W}_{t-1}(j) \equiv E_{t-1} \sum_{\tau=t}^{\infty} \beta^{\tau-t} \left[\ln C_\tau\left(j\right) - \kappa \ell_\tau(j)\right] \quad 0<\beta<1,\ \kappa>0 \tag{1}$$

where β is the discount rate. The instantaneous utility is a positive function of the consumption index $C(j)$ and a negative function of labor effort $\ell(j)$. Foreign agents' preferences are similarly defined: the discount rate is the same as in the Home country, while κ^* in the Foreign country need not coincide with κ in the Home country.

For each agent j in the Home country, the consumption indexes of Home and Foreign brands are defined as:

$$C_{\mathrm{H},t}(j) \equiv \left[\int_0^1 C_t(h,j)^{\frac{\theta-1}{\theta}} dh\right]^{\frac{\theta}{\theta-1}},\ C_{\mathrm{F},t}(j) \equiv \left[\int_0^1 C_t(f,j)^{\frac{\theta^*-1}{\theta^*}} df\right]^{\frac{\theta^*}{\theta^*-1}} \quad \theta,\theta^*>1. \tag{2}$$

where $C_t(h,j)$ and $C_t(f,j)$ are respectively consumption of Home brand h and Foreign brand f by Home agent j at time t. Each Home brand is an imperfect substitute for all other Home brands, with constant elasticity of substitution θ. Similarly the elasticity of substitution among Foreign brands is θ^*. The consumption indexes in the Foreign country, $C^*_{\mathrm{H},t}(j^*)$ and $C^*_{\mathrm{F},t}(j^*)$, are analogously defined.

We assume that the elasticity of substitution between Home and Foreign types is one, thus smaller than the elasticity of substitution between brands of the same type of good produced in each country, θ and θ^*. Under this assumption the consumption baskets of individuals j and j^* can be written as a Cobb-Douglas function of the Home and Foreign consumption indexes:

$$C_t(j) \equiv C_{\mathrm{H},t}(j)^{\gamma} C_{\mathrm{F},t}(j)^{1-\gamma}, \quad C_t^*(j^*) \equiv C_{\mathrm{H},t}^*(j^*)^{\gamma} C_{\mathrm{F},t}^*(j^*)^{1-\gamma} \quad 0 < \gamma < 1 \tag{3}$$

where the weights γ and $1-\gamma$ are identical across countries.

We denote the prices of brands h and f in the Home market (thus expressed in the Home currency) as $p(h)$ and $p(f)$, and the prices in the Foreign market (in Foreign currency) as $p^*(h)$ and $p^*(f)$. Given the prices of brands, we can derive the utility-based price indexes P_{H}, P_{F}, P and their Foreign analogs.[3] In particular, the utility-based CPIs are:

$$P_t = \frac{P_{\mathrm{H},t}^{\gamma} P_{\mathrm{F},t}^{1-\gamma}}{\gamma_W}, \qquad P_t^* = \frac{\left(P_{\mathrm{H},t}^*\right)^{\gamma} \left(P_{\mathrm{F},t}^*\right)^{1-\gamma}}{\gamma_W} \qquad \gamma_W \equiv \gamma^{\gamma}(1-\gamma)^{1-\gamma}. \tag{4}$$

Each brand h is produced by a single Home agent and sold in both countries under conditions of monopolistic competition. Output is denoted Y. Technology is linear in household's h labor, $\ell(h)$. The resource constraint for brand h is:

$$Y_t(h) = \frac{\ell_t(h)}{\alpha_t} \geq \int_0^1 C_t(h,j)dj + \int_0^1 C_t^*(h,j^*)dj^* \tag{5}$$

where α is a country-specific productivity shock. The resource constraint for Foreign brand f is similarly defined as a function of the productivity shock in the Foreign country, α^*. We define as *symmetric* a sequence of shocks α_t, α_t^* such that the following relation holds:

$$\alpha_t^* = \lambda_{t-1}\alpha_t \qquad \lambda_{t-1} > 0 \quad \forall t \tag{6}$$

where λ_{t-1} can fluctuate randomly over time but is known at time $t-1$.

[3] For instance, the utility-based price index $P_{\mathrm{H},t}$ is defined as the minimum expenditure required to buy one unit of the composite good $C_{\mathrm{H},t}$ and is derived as $P_{\mathrm{H},t} = \left[\int_0^1 p_t(h)^{1-\theta}dh\right]^{\frac{1}{1-\theta}}$.

Home agent j receives a revenue $R(j)$ from the sale of the good she produces. Since each agent is the sole producer of a specific brand, we associate individual j with brand h. The sales revenue of agent j, expressed in Home currency, is:

$$R_t(j) \equiv p_t(h) \int_0^1 C_t(h,j)dj + \mathcal{E}_t p_t^*(h) \int_0^1 C_t(h,j^*)dj^* \tag{7}$$

where $\mathcal{E}$ is the nominal exchange rate, defined as Home currency per unit of Foreign currency.

Home agents hold two international bonds, B_{H} and B_{F}, respectively denominated in Home and Foreign currency.[4] The individual flow budget constraint for agent j in the Home country is:

$$\begin{aligned} &B_{\mathrm{H},t+1}(j) + \mathcal{E}_t B_{\mathrm{F},t+1}(j) \leq (1+i_t)B_{\mathrm{H},t}(j) + (1+i_t^*)\mathcal{E}_t B_{\mathrm{F},t}(j) \\ &+R_t(j) - \int_0^1 p_t(h)C_t(h,j)dh - \int_0^1 p_t(f)C_t(f,j)df \end{aligned} \tag{8}$$

In the expression above the short-term nominal rates i_t and i_t^* are paid at the beginning of period t and are known at time $t-1$. The two short-term rates are directly controlled by the national governments.[5] Similar expressions hold for the Foreign country, after associating household j^* with brand f. International bonds are in zero net supply:

$$\int_0^1 B_{\mathrm{H},t}(j)dj + \int_0^1 B_{\mathrm{H},t}^*(j^*)dj^* = 0, \quad \int_0^1 B_{\mathrm{F},t}(j)dj + \int_0^1 B_{\mathrm{F},t}^*(j^*)dj^* = 0. \tag{9}$$

Taking prices as given, Home agent j maximizes (1) subject to (8) with respect to consumption and asset holdings. A similar optimization problem

[4] We adopt the notation of Obstfeld and Rogoff [1996, ch.10]. Specifically, our timing convention has $B_{\mathrm{H},t}(j)$ and $B_{\mathrm{F},t}(j)$ as agent j's nominal bonds accumulated during period $t-1$ and carried over into period t.

[5] The adoption of a cash-less economy framework is merely motivated in terms of analytical convenience. All the results of this model go through when money demand is explicitly considered. Liquidity demand could easily be introduced in the model through a cash-in-advance constraint of the type $M_t(j) = P_t C_t(j)$ and $M_t^*(j) = P_t^* C_t^*(j^*)$, or through a money-in-utility-function framework as in Corsetti and Pesenti [2001 a]. In both cases money demand would be residually determined in equilibrium as a function of nominal interest rates.

is solved by Foreign agent j^*. In our analysis below we focus on symmetric equilibria in which at some initial point in time $t = 0$ all agents have zero net financial wealth. As shown in Corsetti and Pesenti [2001a, b], in equilibrium wealth is zero at *any* subsequent point in time: Home imports from Foreign are always equal in value to Foreign imports from Home. Since agents are equal within countries (though not necessarily symmetric across countries) we can drop the indexes j and j^* and interpret all variables in per-capita (or aggregate) terms. As trade and the current account are always balanced, countries consume precisely their aggregate sales revenue:

$$R_t - P_t C_t = 0, \quad R_t^* - P_t^* C_t^* = 0. \tag{10}$$

2.2 Nominal rigidities, exchange rate pass-through and price setting

It is assumed that agents set the nominal price of their product one period in advance, and stand ready to meet demand at given prices for one period. In terms of our notation, Home firms selling in the Home market choose $p_t(h)$ at time $t-1$ by maximizing (1) subject to (8) with respect to $p_t(h)$, accounting for (5) and (7).[6] As shown in Corsetti and Pesenti [2001a], in an environment in which national agents are symmetric (i.e. all prices $p_t(h)$ are equal and $p_t(h) = P_{\mathrm{H},t}$), Home firms optimally set domestic prices equal to expected nominal marginal cost MC_t (equal to $\kappa \alpha_t P_t C_t$ in our model), augmented by

[6] Standard intratemporal optimization yields agent j's demand for brand h as a function of the relative price of h and total consumption of Home goods:

$$C_t(h, j) = \left(p_t(h)/P_{\mathrm{H},t}\right)^{-\theta} C_{\mathrm{H},t}(j)$$

Similar expressions can be derived for the other brands. Accounting for the demand functions above, we can rewrite the resource constraint for agents h in the Home country as:

$$\ell(h)/\alpha_t \geq p_t(h)^{-\theta} P_{\mathrm{H},t}^{\theta} C_{\mathrm{H},t} + p_t^*(h)^{-\theta} \left(P_{\mathrm{H},t}^*\right)^{\theta} C_{\mathrm{H},t}^*$$

and sales revenue as:

$$R_t(j) = p_t(h)^{1-\theta} P_{\mathrm{H},t}^{\theta} C_{\mathrm{H},t} + \mathcal{E}_t p_t^*(h)^{1-\theta} \left(P_{\mathrm{H},t}^*\right)^{\theta} C_{\mathrm{H},t}^*$$

the equilibrium markup $\theta/(\theta-1)$:

$$p_t(h) = P_{\mathrm{H},t} = \frac{\theta}{\theta-1} E_{t-1}\left[\kappa \alpha_t P_t C_t\right] = \frac{\theta}{\theta-1} E_{t-1}\left[MC_t\right] \tag{11}$$

Home firms selling abroad also set nominal prices one period in advance. Different from most models in the literature, however, we do not impose a priori the restriction that export prices are set in Home currency, implying that all unexpected fluctuations in the exchange rate are ‘passed through’ one-to-one onto export prices in Foreign currency (in the literature this scenario is referred to as ‘Producer Currency Pricing’ or PCP). At the same time, we do not impose a priori the opposite restriction that export prices are set in Foreign currency, implying that Foreign-currency prices of Home goods do not respond at all to unexpected exchange rate fluctuations (i.e. the case of ‘Local Currency Pricing’ or LCP). We consider instead the more general case in which Home firms are allowed to modify the Foreign-currency price of their exports contingent on the realization of the exchange rate, even though pass-through onto export prices can be less than perfect.

Formally, Foreign-currency prices of Home brands are modelled as:

$$p_t^*(h) \equiv \frac{\tilde{p}_t(h)}{\mathcal{E}_t^{\eta_t^*}} \qquad 0 \leq \eta_t^* \leq 1 \tag{12}$$

where the variable $\tilde{p}_t(h)$ is the predetermined component of the Foreign currency price of good h that cannot be adjusted to variations of the exchange rate during period t. Home firms choose $\tilde{p}_t(h)$ one period in advance at time $t-1$ by maximizing (1) as above, while the actual $p_t^*(h)$ depends on the realization of the exchange rate at time t. The parameter η_t^* indexes the degree of pass-through in the Foreign markets.[7] Although the degree of pass-through can vary over time, its level at time t is chosen at time $t-1$ when prices are set.[8]

In equilibrium, we obtain:

[7]For instance, if $\eta^* = 1$, pass-through in the Foreign country is complete — as in the PCP case. If $\eta^* = 0$, we have $p_t^*(h) = \tilde{p}_t(h)$ which coincides with the price chosen by the Home producer in the LCP case.

[8]The model could be easily extended to encompass the case in which the pass-through elasticity is a non-linear function of the exchange rate (e.g., η^* is close to zero for small changes of the exchange rate $\mathcal{E}$ but close to one for large exchange rate fluctuations).

$$p_t^*(h) = P_{\mathrm{H},t}^* = \frac{\tilde{p}_t(h)}{\mathcal{E}_t^{\eta_t^*}} = \frac{\theta}{\theta-1}\frac{E_{t-1}\left[\kappa\alpha_t P_t^* C_t^* \mathcal{E}_t^{\eta_t^*}\right]}{\mathcal{E}_t^{\eta_t^*}} = \frac{\theta}{\theta-1}\frac{E_{t-1}\left[MC_t/\mathcal{E}_t^{1-\eta_t^*}\right]}{\mathcal{E}_t^{\eta_t^*}} \tag{13}$$

Interpreting (13), domestic firms set $\tilde{p}_t(h)$ such that at the margin the expected disutility from an increase in labor effort is equal to the expected utility from consumption financed by additional sales revenue.

Analogous expressions can be derived for the prices set by Foreign firms in the Foreign and the Home market. Define the function:

$$p_t(f) = \tilde{p}_t^*(f)\mathcal{E}_t^{\eta_t}, \qquad 0 \leq \eta_t \leq 1. \tag{14}$$

The degree of pass-through in the Home country, η_t, need not be equal to that in the Foreign country, η_t^*. The optimal pricing strategy is such that:

$$P_{\mathrm{F},t}^* = \frac{\theta^*}{\theta^*-1}E_{t-1}\left[MC_t^*\right], \quad P_{\mathrm{F},t} = \frac{\theta^*}{\theta^*-1}\mathcal{E}_t^{\eta_t}E_{t-1}\left[MC_t^*\mathcal{E}_t^{1-\eta_t}\right] \tag{15}$$

Clearly, Home firms are willing to supply goods at given prices as long as their *ex-post* markup does not fall below one:

$$P_{\mathrm{H},t} \geq MC_t, \quad P_{\mathrm{H},t}^* \geq \frac{MC_t}{\mathcal{E}_t} \tag{16}$$

Otherwise, agents would be better off by not accommodating shocks to demand. In what follows, we restrict the set of shocks so that the 'participation constraint' (16) and its Foreign analog are never violated.

2.3 Monetary policy and the closed-form solution of the model

Before deriving the general solution of the model, it is helpful to introduce an index of monetary stance μ_t such that:

$$\frac{1}{\mu_t} = \beta(1+i_{t+1})E_t\left(\frac{1}{\mu_{t+1}}\right) \tag{17}$$

or, integrating forward,

$$\frac{1}{\mu_t} = E_t \lim_{N\to\infty} \beta^N \frac{1}{\mu_{t+N}} \prod_{\tau=0}^{N-1} (1 + i_{t+\tau+1}) \tag{18}$$

The above expression shows that the index of monetary stance is a function of both current and future expected Home nominal interest rates: Home monetary easing at time t (a higher μ_t) reflects either an interest rate cut at time t (i.e., a lower i_{t+1}) or expectations of future interest rates cuts. A similar expression holds for the Foreign country.

Note that in equilibrium μ_t is equal to $P_t C_t$[9] (and μ_t^* is equal to $P_t^* C_t^*$): a monetary expansion delivers increased nominal spending. A *monetary union* in our framework is defined as a regime in which $i_{t+1} = i_{t+1}^*$ for all t. If both countries adopt the same *numeraire*, this implies $\mu_t = \mu_t^*$.

Table 1 presents the general solution of the model, in which all endogenous variables (19) through (28) are expressed in closed form as functions of real shocks (α_t and α_t^*) and monetary stances (μ_t and μ_t^*).[10]

Interpreting Table 1: since the equilibrium current account is always balanced (see (10) above), the nominal exchange rate $\mathcal{E}_t$ in (19) is proportional to $P_t C_t / P_t^* C_t^*$, that is, a function of the relative monetary stance.[11] The relations (20) link marginal costs to macroeconomic shocks and monetary policy. Domestic prices of domestic goods are predetermined according to (21) and (24), while import prices vary with the exchange rate, depending on the degree of exchange rate pass-through according to (22) and (23). Equilibrium consumption is determined in (25) and (26). Finally employment and output[12] levels are determined according to (27) and (28).

[9] This result can be obtained by comparing the Home Euler equation with logarithmic utility, $1 = \beta (1 + i_{t+1}) E_t (P_t C_t / P_{t+1} C_{t+1})$, with (17).

[10] Algebraic details can be found in the Appendix of Corsetti and Pesenti [2001a]. Note that the solution does not hinge upon any specific assumption or restriction on the nature of the shocks besides the participation constraints (16) and their Foreign analogs.

[11] Note that the exchange rate is a forward-looking variable, as it depends on current and expected future changes in short-term nominal interest rates in the world economy.

[12] Recall that national outputs Y_t and Y_t^* are respectively equal to ℓ_t / α_t and ℓ_t^* / α_t^*.

Table 1: The closed-form solution of the model

$$\mathcal{E}_t = \frac{1-\gamma}{\gamma}\frac{\mu_t}{\mu_t^*} \tag{19}$$

$$MC_t = \kappa\alpha_t\mu_t \qquad MC_t^* = \kappa^*\alpha_t^*\mu_t^* \tag{20}$$

$$P_{\mathrm{H},t} = \frac{\theta}{\theta-1}E_{t-1}\left(MC_t\right) \tag{21}$$

$$P_{\mathrm{F},t} = \frac{\theta^*}{\theta^*-1}\mathcal{E}_t^{\eta_t}E_{t-1}\left[MC_t^*\mathcal{E}_t^{1-\eta_t}\right] \tag{22}$$

$$P_{\mathrm{H},t}^* = \frac{\theta}{\theta-1}\frac{E_{t-1}\left[MC_t/\mathcal{E}_t^{1-\eta_t^*}\right]}{\mathcal{E}_t^{\eta_t^*}} \tag{23}$$

$$P_{\mathrm{F},t}^* = \frac{\theta^*}{\theta^*-1}E_{t-1}\left(MC_t^*\right) \tag{24}$$

$$C_t = \frac{\gamma_W\left(\frac{\theta-1}{\theta}\right)^{\gamma}\left(\frac{\theta^*-1}{\theta^*}\right)^{1-\gamma}\mu_t\mathcal{E}_t^{-\eta_t(1-\gamma)}}{\left[E_{t-1}\left(MC_t\right)\right]^{\gamma}\left[E_{t-1}\left(MC_t^*\mathcal{E}_t^{1-\eta_t}\right)\right]^{1-\gamma}} \tag{25}$$

$$C_t^* = \frac{\gamma_W\left(\frac{\theta-1}{\theta}\right)^{\gamma}\left(\frac{\theta^*-1}{\theta^*}\right)^{1-\gamma}\mu_t^*\mathcal{E}_t^{\eta_t^*\gamma}}{\left[E_{t-1}\left(MC_t/\mathcal{E}_t^{1-\eta_t^*}\right)\right]^{\gamma}\left[E_{t-1}\left(MC_t^*\right)\right]^{1-\gamma}} \tag{26}$$

$$\ell_t = \left(\frac{\theta-1}{\theta\kappa}\right)\left[\gamma\frac{MC_t}{E_{t-1}\left(MC_t\right)} + (1-\gamma)\frac{MC_t/\mathcal{E}_t^{1-\eta_t^*}}{E_{t-1}\left[MC_t/\mathcal{E}_t^{1-\eta_t^*}\right]}\right] \tag{27}$$

$$\ell_t^* = \left(\frac{\theta^*-1}{\theta^*\kappa^*}\right)\left[(1-\gamma)\frac{MC_t^*}{E_{t-1}\left(MC_t^*\right)} + \gamma\frac{MC_t^*\mathcal{E}_t^{1-\eta_t}}{E_{t-1}\left[MC_t^*\mathcal{E}_t^{1-\eta_t}\right]}\right] \tag{28}$$

3 Optimal exchange rate pass-through for *given* monetary policy

What is the optimal degree of exchange rate pass-through onto export prices of Home goods in the Foreign market? Taking monetary stances and policy rules as given, Home firms choose η^* as to maximize (1). In a symmetric environment with $p^*(h) = P^*_{\mathrm{H}}$ the first order condition is:[13]

$$1 = \frac{\theta\,\kappa}{\theta - 1}\frac{E_{t-1}\left[\left(\alpha_t P^*_t C^*_t \ln\mathcal{E}_t\right)/P^*_{\mathrm{H},t}\right]}{E_{t-1}\left[\ln\mathcal{E}_t\right]} \tag{29}$$

Comparing (29) with (13), it follows that the optimal pass-through η^* is such that:

$$E_{t-1}\left[\alpha_t\mu^*_t\mathcal{E}_t^{\eta^*_t}\right] = \frac{E_{t-1}\left[\alpha_t\mu^*_t\mathcal{E}_t^{\eta^*_t}\ln\mathcal{E}_t\right]}{E_{t-1}\left[\ln\mathcal{E}_t\right]} \tag{30}$$

or, rearranging:

$$Cov_{t-1}\left[MC_t/\mathcal{E}_t^{1-\eta^*_t}, \ln\mathcal{E}_t\right] = 0 \tag{31}$$

This is a key condition. At an optimum, the (reciprocal of the) markup in the export market must be uncorrelated with the (log of the) exchange rate. Trivially, if $\mathcal{E}$ is constant or fully anticipated, *any* degree of pass-through is consistent with the previous expression. But if $\mathcal{E}$ is not perfectly predictable, the optimal degree of pass-through will depend on the expected monetary policies and the structure of the shocks.[14] By the same token, the optimal pass-through chosen by Foreign firms selling in the Home market requires:

$$Cov_{t-1}\left(MC^*_t\mathcal{E}_t^{1-\eta_t}, \ln\left(1/\mathcal{E}_t\right)\right) = 0. \tag{32}$$

[13] The optimal pass-through solves:

$$0 = E_{t-1}\Big[-\kappa\tilde{p}_t(h)^{-\theta}\theta\ln\mathcal{E}_t\exp\left\{\eta^*_t\theta\ln\mathcal{E}_t\right\}\left(P^*_{\mathrm{H},t}\right)^{\theta}\alpha_t C^*_{\mathrm{H},t}$$
$$-\mathcal{E}_t\tilde{p}_t(h)^{1-\theta}\left(1-\theta\right)\ln\mathcal{E}_t\exp\left\{-\eta^*_t\left(1-\theta\right)\ln\mathcal{E}_t\right\}\left(P^*_{\mathrm{H},t}\right)^{\theta}C^*_{\mathrm{H},t}/P_tC_t\Big]$$

and equilibrium conditions imply: $P^*_{\mathrm{H},t}C^*_{\mathrm{H},t}/\gamma = P^*_tC^*_t = P_tC_t/\mathcal{E}_t$.

[14] When monetary policy is exogenous (suboptimal) and firms are only allowed to choose between zero and 100 percent pass-through (that is, between local-currency and producer-currency pricing), the formula above is consistent with the analysis of Devereux and Engel [2001] and Bacchetta and van Wincoop [2001].

To build intuition, suppose that the Home marginal cost is uncorrelated with the exchange rate (this would be the case if Home monetary policy were deterministic and Foreign monetary policy did not respond to Home shocks). In this case the optimal pass-through chosen by Home firms is 100 percent: Home firms let their export prices absorb fluctuations of the exchange rate in order to avoid uncertainty of markup and profitability in the Foreign market. Suppose instead that domestic marginal costs move one to one with the exchange rate (this would be the case if there were no Home productivity shocks and Foreign monetary policy were deterministic). In this case the optimal pass-through for Home firms selling abroad is zero: maintaining export prices constant in Foreign currency is the best strategy to avoid fluctuations in export markups.

Patterns of endogenous intermediate pass-through can emerge, as the following example illustrates. If the Home monetary authority adopted the policy $\mu_t = (\alpha_t^2 \mu_t^*)^{-1}$, then it would be optimal for Home firms to choose $\eta_t^* = 0.5$. Abroad, we would need $MC_t^* \mathcal{E}_t^{1-\eta_t}$ to be uncorrelated with the exchange rate. This would be the case, for instance, if $\mu_t^* = \alpha_t^4 / (\alpha_t^*)^5$ and $\eta_t = 0.6$.

4 Optimal monetary policy for *given* exchange rate pass-through

Consider now the policymakers' problem in a world Nash equilibrium where national monetary authorities are able to commit to preannounced rules, taking the pass-through coefficients as given.[15] The problem faced by the Home monetary authority is to maximize the indirect utility of the Home representative consumer (1) with respect to $\{\mu_{t+\tau}\}_{\tau=0}^{\infty}$ for given $\{\mu_\tau^*, \alpha_\tau, \alpha_\tau^*, \eta_\tau, \eta_\tau^*\}_{\tau=t}^{\infty}$. The Foreign authority faces a similar problem. Table 2 presents the closed-form reaction functions, the solution to which is the global Nash equilibrium.[16]

[15] For an analysis of optimal monetary behavior under discretion see Corsetti and Pesenti [2001 a].

[16] As well known, in this class of models optimal monetary rules such as the reaction functions of Table 2 do not provide a nominal anchor to pin down nominal expectations. The issue can be addressed by assuming that governments set national nominal anchors (such as target paths for P_{H} and P_{F}^*) and credibly threaten to tighten monetary policy if the price of domestic goods deviates from the target. Such threats, however, are never

Table 2: Monetary authorities' optimal reaction functions

$$\begin{aligned}
\gamma+(1-\gamma)(1-\eta_t) &= \frac{\gamma MC_t}{E_{t-1}(MC_t)}+\frac{(1-\gamma)(1-\eta_t)\,MC_t^*\mathcal{E}_t^{1-\eta_t}}{E_{t-1}\left(MC_t^*\mathcal{E}_t^{1-\eta_t}\right)} \\
&= \frac{\gamma\dfrac{\theta\kappa}{\theta-1}\ell_t}{\gamma+(1-\gamma)\dfrac{P_{\mathrm{H},t}}{\mathcal{E}_tP^*_{\mathrm{H},t}}}+\frac{(1-\gamma)(1-\eta_t)\dfrac{\theta^*\kappa^*}{\theta^*-1}\ell_t^*}{\gamma+(1-\gamma)\dfrac{P_{\mathrm{F},t}}{\mathcal{E}_tP^*_{\mathrm{F},t}}} \qquad (33)
\end{aligned}$$

$$\begin{aligned}
1-\gamma+\gamma(1-\eta_t^*) &= \frac{(1-\gamma)\,MC_t^*}{E_{t-1}(MC_t^*)}+\frac{\gamma(1-\eta_t^*)\,MC_t/\mathcal{E}_t^{1-\eta_t^*}}{E_{t-1}\left(MC_t/\mathcal{E}_t^{1-\eta_t^*}\right)} \\
&= \frac{(1-\gamma)\dfrac{\theta^*\kappa^*}{\theta^*-1}\ell_t^*}{1-\gamma+\gamma\dfrac{\mathcal{E}_tP^*_{\mathrm{F},t}}{P_{\mathrm{F},t}}}+\frac{\gamma(1-\eta_t^*)\dfrac{\theta\kappa}{\theta-1}\ell_t}{1-\gamma+\gamma\dfrac{\mathcal{E}_tP^*_{\mathrm{H},t}}{P_{\mathrm{H},t}}} \qquad (34)
\end{aligned}$$

To facilitate an intuitive understanding of the formulas, each reaction function is written in two ways: as a function of marginal costs and markups, or as a function of employment gaps and deviations from the law of one price.

An optimal policy requires that the Home monetary stance be eased (μ increases) in response to a positive domestic productivity shock (α falls). Absent a policy reaction, a positive productivity shock would create both an output and an employment gap. In fact, ℓ would fall below $(\theta-1)/(\theta\kappa)$. Actual output Y would not change, but potential output, defined as the

implemented in equilibrium. See e.g. Woodford [2002] and the Appendix of Corsetti and Pesenti [2001a].

equilibrium output the economy could reach if prices were fully flexible, would increase. In light of this, optimal monetary policy leans against the wind and moves to close the employment and output gaps.

In general, however, the optimal response to a Home productivity shock will not close the output gap completely. Home stabilization policy, in fact, induces fluctuations in the exchange rate that add uncertainty to Foreign firms' profits from the Home market. For instance, a depreciation of the Home currency reduces the revenue of Foreign firms exporting to Home, as $P_{\mathrm{F}}/\mathcal{E}$ falls by a percentage $1-\eta$ with the movement in the exchange rate. *Ex-ante*, Foreign agents will require compensation for the additional risk they face in the Home market. They will therefore pre-set higher prices on their exports, lowering Home consumption on average.

This is why the Home monetary adjustment required to close the domestic output gap is not optimal. Relative to such stance, domestic policymakers can improve utility by adopting a policy that equates, at the margin, the benefit from keeping domestic output close to its potential level with the loss from lower consumption (due to the effects of exchange rate volatility on the level of import prices).

As long as η is below one, the Home monetary stance tightens when productivity worsens abroad and loosens otherwise. Rising costs abroad (an increase in α^*) lower the markup of Foreign goods sold at Home. If Home policymakers were not expected to intervene and stabilize the markup by hiking rates and appreciating the exchange rate, Foreign firms would charge higher prices onto Home consumers. Only when $\eta = 1$ do Foreign firms realize that any attempt by the Home authorities to stabilize the markup is bound to fail as both P_{F} and the exchange rate fall in the same proportion.

With complete pass-through in both countries, the policies in a Nash equilibrium are:

$$\mu_t = \frac{E_{t-1}\left(\alpha_t \mu_t\right)}{\alpha_t} \qquad \mu_t^* = \frac{E_{t-1}\left(\alpha_t^* \mu_t^*\right)}{\alpha_t^*} \tag{35}$$

Monetary authorities optimally stabilize marginal costs and markups. Output gaps are fully closed and employment remains unchanged at the potential level $(\theta-1)/(\theta\kappa)$ or $(\theta^*-1)/(\theta^*\kappa^*)$. Both domestic and global consumption endogenously co-move with productivity shocks. Thus, the Nash optimal monetary policy supports the same allocation as would flexible prices. This result provides an extreme version of the case for flexible exchange rates made by Friedman [1953]: even without price flexibility, monetary authorities can engineer the right adjustment in relative prices through exchange rate movements. In our model with PCP, expenditure-switching effects makes exchange rate and price movements perfect substitutes.

The Nash equilibrium will however *not* coincide with a flex-price equilibrium when the pass-though is less than perfect in either market. Consider for instance the case of LCP.[17] In this case the optimal monetary policy in each country cannot be inward-looking, and must instead respond *symmetrically* to shocks anywhere in the world economy. The optimal monetary policy in Table 2 can in fact be written as:

$$\mu_t = \left[\gamma \frac{\alpha_t}{E_{t-1}\left(\alpha_t \mu_t\right)} + (1-\gamma) \frac{\alpha_t^*}{E_{t-1}\left(\alpha_t^* \mu_t\right)} \right]^{-1} \tag{36}$$

$$\mu_t^* = \left[\gamma \frac{\alpha_t}{E_{t-1}\left(\alpha_t \mu_t^*\right)} + (1-\gamma) \frac{\alpha_t^*}{E_{t-1}\left(\alpha_t^* \mu_t^*\right)} \right]^{-1}, \tag{37}$$

expressions that imply $\mu = \mu^*$. For any given shock, consumption increases by the same percentage everywhere in the world economy. Even if labor effort responds asymmetrically to the shocks in the two countries (so that post-shock welfare at Home is not identical to welfare abroad, as is the case under PCP), the expected (before-shock) disutility from labor is constant. Thus, expected utility at Home is identical to expected utility in the Foreign country up to a term that does not depend on monetary policy.

In our model the exchange rate is a function of the relative monetary stance μ/μ^*. Our analysis then suggests that exchange rate volatility will be higher in a world economy close to purchasing power parity, and lower in a world economy where deviations from the law of one price are large. In fact, if the exposure of firms' revenue to exchange rate fluctuations is limited, inward-looking policymakers assign high priority to stabilizing domestic output and prices, with 'benign neglect' of exchange rate movements. Otherwise, policymakers 'think globally', taking into account the repercussions of exchange rate volatility on import prices; hence, the monetary stances in the world economy come to mimic each other, reducing currency volatility.

The characterization of *optimal monetary unions* is a simple corollary of the analysis above. We define a monetary union $\mu_t = \mu_t^*$ as optimal if the

[17] See the discussion in Devereux and Engel [2000].

single monetary stance μ_t is optimal for both countries. It is straightforward to show that when shocks are *symmetric* — as defined in (6) above — the optimal allocation is such that $MC_t = E_{t-1}(MC_t)$, $MC_t^* = E_{t-1}(MC_t^*)$, and $\mathcal{E}_t = E_{t-1}\mathcal{E}_t$ regardless of the degree of pass-through. If λ is constant over time in (6), optimal monetary policies support a fixed exchange rate regime and an optimal monetary union while fully closing the national output gaps. If shocks are *not symmetric*, a monetary union is optimal only when both countries find it optimal to choose a symmetric monetary stance, that is, when pass-through is zero worldwide.

5 Optimal exchange rate pass-through *and* monetary policy in equilibrium

Recapitulating: Home and Foreign firms choose the levels of pass-through η_t^* and η_t on the basis of their information at time $t-1$ regarding marginal costs and exchange rates at time t, by solving (31) and (32). Home and Foreign monetary authorities take the levels of pass-through η_t^* and η_t as given and determine their optimal monetary stances by solving the conditions (33) and (34). We now consider the joint determination of μ_t, μ_t^*, η_t and η_t^* satisfying the four equations above in the non-trivial case in which the shocks α_t and α_t^* are not symmetric.

The following allocation is an equilibrium:

$$\begin{aligned} &MC_t = E_{t-1}(MC_t), \; MC_t^* = E_{t-1}(MC_t^*) \\ &\eta_t = \eta_t^* = 1 \end{aligned} \tag{38}$$

Purchasing power parity holds and there is full pass-through of exchange rate changes into prices. Monetary policies fully stabilize the national economies by closing output and employment gaps. Exchange rates are highly volatile, their conditional variance being proportional to the volatility of α_t^*/α_t. We will refer to this equilibrium as an *optimal float* (OF).

The logic underlying the OF case can be understood as follows. Suppose Foreign firms selling in the Home market choose $\eta = 1$ and let Home-currency prices of Foreign goods move one-to-one with the exchange rate, stabilizing their markups. Then the Home monetary authority chooses as a rule to stabilize Home output fully, no matter the consequences for the exchange rate (the volatility of which does *not* affect Foreign exporters' expected profitability and therefore does not affect, on average, the price of Foreign goods paid by Home consumers). Note that when $\eta = 1$, Home output stabilization implies that MC is a constant. But this implies that the marginal costs of Home firms are uncorrelated with the exchange rate. Thus, Home firms will optimally set their pass-through abroad and choose $\eta^* = 1$ in order to stabilize the markup on their exports to the Foreign country. Since Home firms are now fully insulated from exchange rate fluctuations, the Foreign monetary authority optimally chooses to stabilize Foreign output with benign neglect of the exchange rate, so that MC^* is a constant. But in this case Foreign firms optimally choose $\eta = 1$ as we had assumed initially: the OF case is an equilibrium.

Consider now the following allocation:

$$\begin{aligned} 1 &= \gamma \frac{MC_t}{E_{t-1}(MC_t)} + (1-\gamma)\frac{MC_t^*}{E_{t-1}(MC_t^*)}, \qquad \mathcal{E}_t = const \\ \eta_t &= \eta_t^* = 0 \end{aligned} \tag{39}$$

This is the LCP scenario brought to its extreme consequences: there is no pass-through of exchange rate changes into prices, but this hardly matters since the exchange rate is fixed! Optimal national monetary policies are fully symmetric, thus cannot insulate the national economies from asymmetric shocks: it is only on average that they stabilize the national economies by closing output and employment gaps — the most apparent case of an optimal currency area.

To see why the previous scenario an equilibrium, note that if Home and Foreign firms choose $\eta = \eta^* = 0$, Home and Foreign authorities are concerned with the price-distortions of exchange rate volatility. Their optimal stances maximize over the trade-off between employment stability and consumers' purchasing power. While they choose their rules independently of each other, the rules they adopt are fully symmetric, thus leading to exchange rate stability. But if the exchange rate is constant, the choice of the pass-through is no longer a concern for Home and Foreign firms: zero pass-through is as good as a choice as any other level of η and η^*. Such weak preference implies that the monetary union is an equilibrium.

Would the two allocations above still be equilibrium allocation if national authorities could commit to coordinated policies, maximizing some weighted average of expected utility of the two national representative consumers? This is an important question, as one may argue that policymakers in a monetary union would set their rules together (taking private agents' pricing and pass-through strategies as given), rather than independently. By the same token, if there were large gains from cooperation in a floating exchange rate regime, there would also be an incentive for policymakers to design the optimal float in a coordinated way. One may well conjecture that, once co-operative policies are allowed for, the equilibrium allocation becomes unique.

Remarkably, it turns out that the possibility of cooperation does not modify at all the conclusions of our analysis. It can be easily shown that optimal policy rules conditional on $\eta, \eta^* = 1$ are exactly the same in a Nash equilibrium and under coordination: there are no gains from cooperation in the PCP scenario which replicates the flex-price allocation.[18] Also, as shown in Corsetti and Pesenti [2001a], optimal policy rules conditional on $\eta, \eta^* = 0$ are identical with and without cooperation: since exchange rate fluctuations are the only source of international spillover, there cannot be gains from cooperation when non-cooperative monetary rules already imply stable exchange rates! While there are policy spillovers for any intermediate degree of pass through $(0 > \eta, \eta^* > 1)$, they disappear in equilibrium under the two extreme pass-through scenarios. In the only two cases relevant for our equilibrium analysis, optimal monetary policy rules are exactly the same whether or not the two policymakers cooperate or play Nash against each other.

6 Endogenous OCAs: Macroeconomics and welfare analysis

Can a monetary union be a self-validating OCA? Our model suggests that the answer is yes. Policy commitment to monetary union — i.e., the adoption of the rules (36-37) — leads profit-maximizing producers to modify their pricing strategies, lowering their pass-through elasticities. Such behavioral change makes a monetary union optimal, even if macroeconomic fundamentals and the pattern of shocks (α_t and α_t^* in our framework) remain unchanged across regimes.

[18]See Obstfeld and Rogoff [2000a,b] and Corsetti and Pesenti [2001a].

A crucial result of our analysis is that, under an OCA, output correlation is higher than under the alternative OF equilibrium. In fact, under OF, monetary policies are such that employment in both countries is always stabilized (both *ex-ante* and *ex-post*) at the constant levels $\ell = (\theta - 1) / (\theta\kappa)$ and $\ell^* = (\theta^* - 1) / (\theta^*\kappa^*)$. This implies that output correlation under OF depends on the degree of asymmetry of the fundamental shocks:

$$Corr\left(Y_t^{OF}, Y_t^{*OF}\right) = Corr\left(\frac{\ell_t^{OF}}{\alpha_t}, \frac{\ell_t^{*OF}}{\alpha_t^*}\right) = Corr\left(\frac{1}{\alpha_t}, \frac{1}{\alpha_t^*}\right) \tag{40}$$

Instead, in a monetary union employment levels are functions of relative shocks:

$$\frac{\theta\kappa}{\theta - 1}\ell_t^{OCA} = \frac{\alpha_t \mu_t^{OCA}}{E_{t-1}\left(\alpha_t \mu_t^{OCA}\right)}, \qquad \frac{\theta^*\kappa^*}{\theta^* - 1}\ell_t^{*OCA} = \frac{\alpha_t^* \mu_t^{OCA}}{E_{t-1}\left(\alpha_t^* \mu_t^{OCA}\right)} \tag{41}$$

where μ^{OCA} is the solution of the system (36)-(37). This implies that output levels are perfectly correlated:

$$Corr\left(Y_t^{OCA}, Y_t^{*OCA}\right) = Corr\left(\frac{\ell_t^{OCA}}{\alpha_t}, \frac{\ell_t^{*OCA}}{\alpha_t^*}\right) = Corr\left(\mu_t^{OCA}, \mu_t^{OCA}\right) = 1 \tag{42}$$

so that $Corr\left(Y_t^{OCA}, Y_t^{*OCA}\right) \geq Corr\left(Y_t^{OF}, Y_t^{*OF}\right)$, consistent with the traditional characterization of OCAs.

It is possible to rank the OF and the OCA regimes in welfare terms. Focusing on the Home country, expected utility $\mathcal{W}$ in (1) can be written as:

$$\mathcal{W}_{t-1} = \mathcal{W}_{t-1}^{flex} - \left[\gamma E_{t-1} \ln\left(\frac{E_{t-1}\left(\alpha_t \mu_t\right)}{\alpha_t \mu_t}\right) + (1 - \gamma) E_{t-1} \ln\left(\frac{E_{t-1}\left[\alpha_t^* \left(\mu_t^*\right)^{\eta_t} \mu_t^{1-\eta_t}\right]}{\alpha_t^* \left(\mu_t^*\right)^{\eta_t} \mu_t^{1-\eta_t}}\right)\right] \tag{43}$$

where $\mathcal{W}_{t-1}^{flex}$ is a term independent of monetary regime, and equal to the utility that consumers could expect to achieve if prices were fully flexible. By Jensen's inequality, the term in square brackets is always non-negative: expected utility with price rigidities is *never* above expected utility with flexible prices. At best, what monetary policy rules can do is to bridge the gap between the two.

Observe that under the OF equilibrium (38) the term in square bracket becomes zero and $\mathcal{W}_{t-1}^{OF} = \mathcal{W}_{t-1}^{flex}$. But this implies that $\mathcal{W}_{t-1}^{OF} \geq \mathcal{W}_{t-1}^{OCA}$, an inequality that holds with strong sign when shocks are asymmetric. It follows that an optimal currency area is always Pareto-inferior *vis-à-vis* a Friedman-style optimal flexible exchange rate arrangement.

7 Discussion and conclusion

The theory of optimal currency areas, from the classic contributions by Mundell [1961], McKinnon [1963], Kenen [1969] and Ingram [1973] to its modern applications and revisions,[19] stresses that asymmetric, country-specific shocks represent a key element in the choice of exchange rate regime. Specifically, asymmetric real shocks weaken the case for a common currency, as member states of a monetary union lose their ability to use domestic exchange rate and interest rate policies for stabilization purposes. Conversely, business cycle synchronization and macroeconomic 'convergence' make a currency area an 'optimal' monetary arrangement, other things being equal, by reducing the scope for asymmetric policy responses to the disturbances hitting the union-wide economy. In terms of our model, an exogenous increase in the correlation of the real shocks leads to closer co-movements in optimal monetary stances for any level of exchange rate pass-through.

The argument for an *endogenous* optimal currency area emphasizes that the monetary union itself could act as a catalyst of business cycle synchronization, essentially by reducing foreign exchange transaction costs and therefore by promoting trade integration across countries. Not everyone agrees with this argument: for instance Eichengreen [1992] and Krugman [1993] stress that monetary integration could lead to greater specialization in production, thus lowering output correlation and making regions more vulnerable to local shocks. On an empirical basis, however, the evidence presented by Frankel and Rose [1998] supports the view that trade links raise income correlations. The conclusion is that the OCA criterion may be satisfied *ex-post* even if it fails *ex-ante.*

But what would happen if monetary integration fails to boost economic convergence and intra-industry trade? Would it still be possible for a monetary union to satisfy *ex-post* the OCA criterion when monetary and real inte-

[19] Those include, among others, Eichengreen [1990, 1992], Dowd and Greenaway [1993], Tavlas [1993], Bayoumi and Eichengreen [1994], Melitz [1996] and Bayoumi [1997]. See Buiter, Corsetti and Pesenti [1998], ch.10, for a critical survey of the literature.

gration fail to move in tandem? In this paper we have shown the existence of two equilibria in a standard open-economy model where the alternative between pricing-to-market and law of one price depends on endogenous choices by firms. This result thus suggests that credible policy commitment to monetary union may lead to a change in pricing strategies, making a monetary union the optimal monetary arrangement in a self-validating way.

It is worth emphasizing that 'optimal' here does not mean that exchange rate adjustments or asymmetric interest rate policies would not be useful for output stabilization. Rather, a currency union is 'optimal' because, for given producers' pricing strategies, the use of the exchange rate for stabilization purposes would entail excessive welfare costs, in the form of higher average import prices and lower purchasing power across countries. In fact, once a monetary union takes off and firms adapt their pricing strategies to the new environment, the best course of action for the monetary authorities is to avoid any asymmetric policy response to asymmetric shocks. As a result, even in the absence of the structural effects of monetary integration stressed by Frankel and Rose [1997, 1998] (e.g., even without an increase in intra-industry trade), national outputs become more correlated than before the creation of the common currency area. In sum, the best institutional device to guarantee a credible policy commitment to a monetary union is to have the monetary union itself in place.

But our model also suggests that the argument for self-validating optimal currency areas could be used in the opposite direction, as an argument for self-validating optimal floating regimes. For a given pattern of macroeconomic disturbances, in fact, policy commitment to a floating regime may be the right choice despite the observed high synchronization of the business cycle across the countries participating in a monetary union: in equilibrium there will be an endogenous change in pricing strategies (with higher pass-through levels world-wide) which support floating rates as the optimal monetary option. In fact, the two institutional corner solutions for exchange rate regimes can be Pareto-ranked in welfare terms, leaving the optimal float the unambiguous winner.

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